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ABSTRACT

The purpose of the study was (1) to examine the results from a two-association perceptual-motor task as to their implications for Luria's theory about the development of verbal control of non-verbal behavior; (2) to explore the effects of various learning experiences upon this development. The sample consisted of 20 randomly selected children in each of 3 age groups (3-4-and 5-year-olds). The children in each group were randomly assigned to 4 treatments. The treatments were adult verbal instructions, visual observation, simulation direct practice and replication. Luria's basic task involved pressing a square block to either a yellow or blue light and a round block to either a blue or yellow light. Four conditions of the task were: (1) overt self-instructions; (2) remaining silent; (3) a reversal of the associations with conditions one and two repeated. A three-way analysis of variance and subanalysis were performed on number of correct responses. Results indicated significant differences in proficiency between age levels--proficiency increases with age. Significant differences were found between the 4 conditions of the task--performance decreased following reversal. The two-association task did differentiate stages in the development of verbal control of nonverbal behavior with high sensitivity for the fully developed specific function of speech. (Author/MH)

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The Development of the Control of Adult Instructions over Non-Verbal Behavior

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Luria and others (1959, 1961a, 1961b) studied the development of the directive regulatory function of speech in young children 2 to 7 years old. Their intent was to observe the accomplishment of a sample action (pressing a balloon) based on verbal instructions.

It was found that the impellent function of the preliminary verbal instructions was stronger than the inhibitory function in 3 to 3 1/2 year olds.

Examining 3 1/2 to 4 year old children it was observed that the child's own overt verbal instructions served as an impellent and inhibitor of motor behavior. When 3 1/2 to 4 year olds performed the task in silence, the non-verbal behavior became uncontrolled and diffused. Luria concluded that children at this age were at the stage of the nonspecific functions of speech--controlling non-verbal behavior by the impellent and inhibitory functions of speech (1961a).

In further experiments Luria (1961a) found that in 4 1/2 to 5 year olds the regulatory function of speech is steadily transferred from the nonspecific function to the specific function of elective significative connections (analytical system). This development was accompanied by a shift from overt to inner speech.

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David Birch (1966) studied children ranging from 2 to 7 years old using the verbal instructions, "Push the bar all the way down and hold it down." The results were consistent with the findings of Luria. Sandra Bem (1967) demonstrated that a system of self-generated cues can be established experimentally in 3 and 4 year old children. Bem concluded that lack of self-instruction is not an innate developmental deficiency.

The purposes of the present study are (1) to analyze the development of verbal control of nonverbal behavior, especially the specific function of speech, using a complicated two-association perceptual-motor task; (2) to study the effects of four initial training methods on the above mentioned development (these four experiences are adult verbal instructions, imitation, simulated practice and direct practice), and (3) to study the differential effects of overt self-instructions, no overt self-instructions during the task, and a reversal of the two associations under adult instructions.

Design of Study

The subjects for this study were 60 nursery school children, 20 children in each of three age groups (mean ages 42 months, 54 months and 66 months).

The apparatus consisted of a gray vertical panel with a single aperture cut in it. Through the aperture a yellow and blue light appeared in random sequence. In front of the vertical panel on the horizontal plane were two keys for pressing. One key was in the shape of a square 1/2" thick and 1 1/2" in length on a side and white in color. The other key was a white round block 1/" thick and 1 1/2" in diameter. The stimulus was 1.96 seconds and inter stimulus interval was 2.47 seconds. The keys and lights were attached to a laboratory timer so that response latencies could be recorded.

Procedure

Each child was trained to color recognition (blue and yellow) and discrimination of geometric forms (square and circle).

The children were randomly assigned to color-geometric associations so that two children were assigned to a blue-square and yellow-round and two children had the reverse association within each cell (age level x treatment).

The absic task was to press the correct key (square or round) to the correct light (blue or yellow). Each child performed the taks under four contitions. On the verbal task the child was requested to call out the correct response square (block) or round (circle) while performing the task. The nonverbal condition repeated the task without calling out the correct response. On reversal condition the children reversed their perceptual-motor associations and performed the task under the verbal and nonverbal conditions. The order of presentation of verbal and nonverbal conditions were randomized within each cell (age by treatment) to control for any order effects.

In treatment one the children were only given adult verbal instructions as follows:

Verbal condition:

"Here is how we play the game. When the blue (yellow) light comes on say 'square' (round) and press the square (round) block."

"What do you say when the blue (yellow) light comes on?"

"What do you do when the blue (yellow) light comes on?"

These instructions were repeated until the child could answer both questions correctly for each association four consecutive times.

The instructions for the nonverbal condition followed the same pattern except that the instructions for saying square and circle were omitted.

The reversal shift instructions were as follows:

"You did so well let's see if you can paly the game with new rules."

"Listen because we are going to change the rules."

"Here are the new rules."

The instructions then followed the same format as previously cited above for verbal and nonverbal tasks with the associations changed.

For treatment two the verbal instruction procedure was repeated plus the child watched the experimenter perform the task.

For treatment three verbal instructions were repeated and the child was instructed in drawing the correct geometric shape under blue and yellow spots.

The fourth treatment consisted of the verbal instruction procedure plus direct practice of the task.

Treatments two through four were initial treatments only.

The fifth treatment was a replication of Luria's basic task. The child was instructed to press a key once to either a blue or yellow light. The press-color association was randomized with each age cell. Verbal instructions similar to treatment one were given and the task was performed under the four conditions (cited above).

Results

Table 1 gives the results of a three-way analysis of variance performed on treatments one, two, three and four (age x treatments x task). A significant difference was found in performance between age groups ($P < .001$). A Significant difference was indicated between task conditions ($P < .05$). No significant difference was found between treatments nor were there any significant interactions.

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Insert Table 1 about here

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Table 2 gives the mean correct scores for age level and task conditions pooled across treatments.

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Insert Table 2 about here

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Using the Scheffé test, it was found that the performance of 5 year olds was significantly different from 4 year olds ($P < .05$) and from 3 year olds ($P < .01$). A significant difference ($P < .01$) was found between the performance

of 4 and 3 year olds.

Using the Scheffé test pooling across age levels and treatments, it was found that there were no real differences between the verbal and nonverbal tasks and the reversal verbal and reversal nonverbal tasks. Significant differences were found between the verbal and reversal verbal tasks ($P < .01$), the verbal and reversal nonverbal task ($P < .01$), the nonverbal and reversal verbal task ($P < .05$), and the nonverbal and reversal nonverbal task ($P < .05$).

Further subanalysis on the differences between task conditions using the scheffe test indicate that there were no significant differences in performance between the various task conditions for 5 year olds, nor were there any for 3 year olds. Significant differences were found between various task conditions for 4 year olds. They were as follows: Between the nonverbal and reversal verbal conditions ($P < .01$) and the nonverbal and reversal nonverbal conditions ($P < .05$). The difference in performance between the verbal and reversal verbal conditions approach the .05 level of significance ($P < .06$).

Table 3 gives the mean correct scores for treatment five, Luria's task. Table 4 gives the results of a two-way analysis of variance performed on the data in Table 3 and indicates a significant difference in performance between age groups. No significant difference was found between task conditions nor was there a significant interaction.

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Insert Table 3 about here

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Insert Table 4 about here

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Using the Scheffé test for subanalysis it was found that there is no real difference between the performance of 5 and 4 year olds. Significant differences

in performance were found between 5 and 3 year olds (P .01), and 4 and 3 year olds (P .05).

Table 5 gives the mean response latencies for the sixteen 5 year olds who verbalized consistently. A one-way analysis of variance indicates that there were no differences between response latencies on various task conditions.

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Insert Table 5 about here

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Table 6 gives the mean response latencies for the eight 4 year olds who verbalized consistently. Table 7 gives the results of an analysis of variance on the data in Table 6. The results indicate a significant difference between response latencies under various task conditions.

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Insert Table 6 about here

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Insert Table 7 about here

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A subanalysis using the procedure for T-test following a significant F ratio indicated no real difference between the verbal and nonverbal conditions and the verbal and reversal nonverbal conditions. Significant differences in response latencies at the .01 level were found between the verbal and reversal verbal conditions, the nonverbal and reversal verbal conditions, and the reversal verbal and reversal nonverbal conditions. A significant difference at the .05 level was indicated between the nonverbal and reversal nonverbal conditions.

Discussion

Aside from the fact that the treatments did not affect performance, the results were basically consistent with Luria's theory of the development of verbal

control of nonverbal behavior. It was expected from the theory that 5 year olds who are functioning at the elective significative level of language would accomplish the task under adult instructions; 4 year olds who according to the theory are functioning at the impellent and inhibitory level of language would find the task difficult because of the mobility and flexibility required but not impossible to perform, and 3 year olds who are responding at the level of the impellent function of language should not be able to perform the task.

Treatment five, the replication of Luria's task, requires a fully developed impellent and inhibitory function of speech according to the theory. One would expect therefore that there should be little or no difference between the 4 and 5 year olds on this task. The results indicate that there is no difference between 4 and 5 year olds and that 3 year olds are significantly different from both 4 and 5 year olds.

The differences between the various conditions were due to the reversal shift-all groups exhibited some decrement in performance following the shift. This varies from Luria's theory in that he predicts that overt-verbalization should facilitate performance. However, since not all children verbalized consistently, no conclusion may be readily drawn. Research on this question needs to be done.

Further analysis indicated no significant differences in performance between task conditions on the two-association experiment (no negative transfer on reversal shift) for 5 year olds. The theory would predict that children at the elective significative level of language could master the shift. Children at the impellent-inhibitory level should exhibit negative transfer due to the shift. The results for 4 year olds indicates significant decrements in performance for 4 year olds following the reversal shift on the two-association experiment. It is interesting to note that on the simpler Luria task no difference was found between task conditions.

The treatments prove to be ineffectual. Since the differences between age group performances were so large, no conclusion may be drawn about the ability to facilitate verbal control of nonverbal behavior.

According to Hull (1943) and Anokin (1961), when two distinct responses are evoked at the same time there will be interference between them unless they are well integrated and coordinated. It therefore follows that if overt self-instructions are integrated in their control of nonverbal behavior, there should be no significant difference in response latency between the verbal and nonverbal conditions of a perceptual-motor task. The results indicate that the 5 year olds who verbalized have integrated (no interference) verbal and motor-perceptual responses. However, the results of the 4 year olds who verbalized indicate that the reversal shift caused longer reponse times and also caused a significant difference in response latencies between the reversal verbal and reversal nonverbal conditions. Until further study has been performed one may say that in 4 year olds the more difficult tasks (i.e., reversal shift) cause longer response latencies and also cause a breakdown in the integration between verbal and motor-perceptual responses.

Since adult verbal instructions are used and assumed in our educational system, it is important to understand how these instructions interact and control other types of behavior. It is conceivable that many children in elementary school have not reached the elective significative function of language and therefore are unable to follow instructions in school. It is obvious in this study that the largest leap in the development of the higher functions of verbal control comes between 3 and 4 year olds. This fact in itself raises many questions as to when preschool education could be most effective in the development of the directive function of language.

What happens to children who for one reason or another have not reached the elective significative level of functioning? How does this affect other

types of verbal learning and classroom behavior? Conceivably, a cognitive deficit in the development of the directive function of speech may be related directly or indirectly to various learning disabilities.

This study basically supports the Russian theory of the second signal system and its regulatory control of conscious behavior. The new and more complicated two-association task differentiates the higher stages in the development of the directive function of speech. Although the learning treatments did not affect the performance of 3 and 4 year olds (the development of the directive function of speech), further study should be done in this area. The differences between task conditions was attributed to a deficit in performance following the reversal shift.

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TABLE 1

Three-Way Analysis of Variance Results for

Treatments One, Two, Three and Four

	DF	MS	F
Age Groups	2	10435.33	113.61**
Subjects within Groups	9	96.95	
Treatments	3	248.21	.91
Treatments x Age Groups	6	102.27	.37
Treatments x Subjects withing Groups	27	273.70	
Tasks	3	142.21	4.13*
Tasks x Age Groups	6	27.37	.80
Tasks x Subjects within Groups	27	34.41	
Tasks x Treatments	9	26.76	0.61
Tasks x Treatments x Age Groups	18	36.01	0.85
Tasks x Treatments x Subjects within Groups	81	42.44	

** $p < .01$

* $p < .05$

TABLE 2

Task Conditions

			Reversal	
Age Groups	Verbal	Nonverbal	Verbal	Nonverbal
5 yrs. old	35.4	33.4	33.9	31.8
4 yrs. old	27.9	29.4	23.7	24.6
3 yrs. old	10.4	9.1	7.4	7.6

TABLE 3

Treatment V

Mean Values

Age Groups	Tasks			
	Verbal	Nonverbal	Verbal	Nonverbal
5 yrs. old	16.8	18.0	18.5	17.0
4 yrs. old	11.0	12.2	9.8	13.5
3 yrs. old	2.8	1.0	4.2	5.0

TABLE 4

Analysis of Variance Results for Treatement V

Source	DF	SS	MS	F
Between Subjects	11	2691.06		
Groups	2	1654.62	827.31	7.18**
Subjects within Groups	9	1036.44	115.16	
Within Subjects	36	210.25		
Tasks	3	16.56	5.52	0.98
Groups x Tasks	6	41.38	6.90	1.22
Tasks x Subjects within Groups	27	152.31	5.64	
Total	47	2901.31		

** $p < .01$

TABLE 5

Response Latency of 5 Year Olds

Mean Values (in seconds)

Initial Condition		Reversal Condition	
Verbal	Nonverbal	Verbal	Nonverbal
1.49	1.22	1.42	1.29

TABLE 6

Response Latency of 4 Year Olds

Mean Values (in seconds)

Initial Condition		Reversal Condition	
Verbal	Nonverbal	Verbal	Nonverbal
1.47	1.27	1.66	1.42

TABLE 7

Analysis of Variance Results for

Response Latency of 4 Year Olds

Source	DF	SS	Var.	F
Between	3	.6072	**.2024**	3.19*
Within	25	.0635		
Total	28	2.1952		

* $p < .05$